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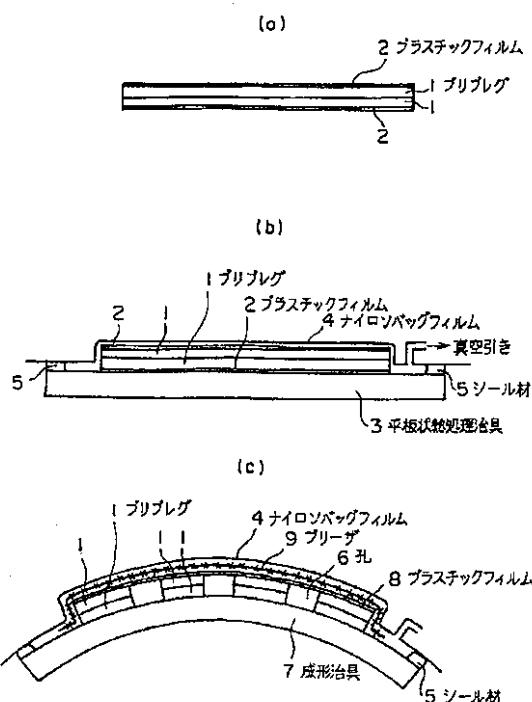
(71)出願人 000006208
三菱重工業株式会社
東京都千代田区丸の内二丁目5番1号
(72)発明者 西山 茂
愛知県名古屋市港区大江町10番地 三菱重工業株式会社名古屋航空宇宙システム製作所内
(74)代理人 弁理士 内田 明 (外2名)

(54)【発明の名称】複合材製多孔面板の製造方法

(57)【要約】

【課題】複合材製多孔面板を製造するに当たって、複合材製多孔面板成形後に大きな加工時間と費用を費やして孔を明けたり、特殊な成形型を準備して複合材製多孔面板成形時に同時に孔明けして多孔面板にするというような製造コスト低減面で不利な方法を改善し、簡単にしかも安価に多孔面板を製造する方法を提供すること。

【解決手段】強化繊維とマトリックス樹脂からなる複合材料成形用素材(プリプレグ)を積層緻密化した後、80~120°Cで1~2時間熱処理し、後行程の硬化の際に樹脂が孔内に流入しない程度に粘度を向上させた状態として孔明け加工した後、加熱・加圧して硬化させることを特徴とする複合材製多孔面板の製造方法。



【特許請求の範囲】

【請求項1】 強化繊維とマトリックス樹脂からなる複合材料成形用素材を積層・緻密化した後、80～120°Cで1～2時間熱処理し、後行程の硬化の際に樹脂が孔内に流入しない程度に粘度を向上させた状態として孔明け加工した後、加熱・加圧して硬化させることを特徴とする複合材製多孔面板の製造方法。

【請求項2】 前記加熱・加圧して硬化させる工程が、熱処理後孔明け加工した複合材料成形用素材を成形型に移し、バッグフィルムを被せて真空引きしたのちオートクレーブ中で加熱・加圧して硬化させるものであることを特徴とする請求項1に記載の複合材製多孔面板の製造方法。

【請求項3】 前記熱処理後孔明け加工した複合材料成形用素材とバッグフィルムの間に金属プレートを介在させることを特徴とする請求項2に記載の複合材製多孔面板の製造方法。

【請求項4】 前記熱処理後孔明け加工した複合材料成形用素材の表面に薄布を介在させることを特徴とする請求項2又は3に記載の複合材製多孔面板の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、軽量化が要求される航空機のエンジンナセル等に適用する複合材製多孔面板の製造方法に関する。

【0002】

【従来の技術】 航空機のエンジンナセル等に適用する複合材製多孔面板の製造においては、面板に貫通孔を設ける何らかの手段が必要である。複合材料成形用素材（以下、プリプレグと称する）を硬化させて成形品とした後で、ドリルやメカニカルパンチを用いて行う公知の方法は比較的に加工時間と費用がかかり、通常、成形品は部品としての形状を有しているためさらに加工が難しくなっている。このような問題を解決する方法の一つとして、型裏面部と型表面部を有し、かつ該型表面部から間隔を置いて突出していく各々先端が尖っている複数のスタッドを有する型を設け、該スタッドの上に部分的に硬化した強化プラスチック含浸シートを載置し、上記スタッドが該シートを貫通するように該シートと該スタッドを押圧し、上記シートを上記型表面に押圧しながら上記シート内のプラスチックを硬化させる工程を有する多孔強化プラスチック部材の製造方法が提案されている（特開昭47-2131号公報）。しかし、この手法も特殊な成形型を部品の形状毎に準備する必要があり、必ずしも加工費用面で得策とはならないことがわかった。

【0003】 本発明者らはこの方法に代わる手段として、予め孔部を形成した強化繊維強化複合材料とマトリックス樹脂からなるプリプレグの孔部に、注型用樹脂を樹脂製薄膜を介して充填し、加熱・加圧して硬化させることを特徴とする複合材製多孔面板の製造方法を提案し

た（特開平8-1690号公報）。この方法は成形加工時間やコストの面で改良効果があるが、注型用樹脂や樹脂製薄膜等の成形用の間接材料が比較的高価なため、さらに安価な製造方法の開発が望まれていた。

【0004】

【発明が解決しようとする課題】 本発明は上記技術水準に鑑みてなされたものであって、複合材製多孔面板を製造するに当たって、複合材製多孔面板成形後に大きな加工時間と費用を費やして孔を明けたり、特殊な成形型を準備して複合材製多孔面板成形時に同時に孔明けして多孔面板にするというような製造コスト低減面で不利な方法を改善し、簡単にしかも安価に多孔面板を製造する方法を提供するものである。

【0005】

【課題を解決するための手段】 前記課題を解決する手段として本発明は次の（1）～（4）の態様を含むものである。

（1）強化繊維とマトリックス樹脂からなる複合材料成形用素材（プリプレグ）を積層緻密化した後、80～120°Cで1～2時間熱処理し、後行程の硬化の際に樹脂が孔内に流入しない程度に粘度を向上させた状態として孔明け加工した後、加熱・加圧して硬化させることを特徴とする複合材製多孔面板の製造方法。

（2）前記加熱・加圧して硬化させる工程が、熱処理後孔明け加工したプリプレグを成形型に移し、バッグフィルムを被せて真空引きしたのちオートクレーブ中で加熱・加圧して硬化させるものであることを特徴とする前記（1）の複合材製多孔面板の製造方法。

（3）前記熱処理後孔明け加工したプリプレグとバッグフィルムの間に金属プレートを介在させることを特徴とする前記（2）の複合材製多孔面板の製造方法。

（4）前記熱処理後孔明け加工したプリプレグの表面に薄布を介在させることを特徴とする前記（2）又は（3）の複合材製多孔面板の製造方法。

【0007】

【発明の実施の形態】 本発明で使用するプリプレグはガラス繊維、炭素繊維、シリカ繊維、アルミナ繊維などの強化繊維で織られた強化用の織り布と、エポキシ樹脂、ビスマレイミド樹脂、ポリエステル樹脂、フェノール樹脂、ポリイミド樹脂などのマトリックス樹脂で構成されたものが好ましいが、繊維を一方向に引きそろえて樹脂を含浸したUD（Uni-Directional）プリプレグも使用できる。このプリプレグは未処理の状態で孔明けした後、加熱・加圧して硬化させると、硬化時に樹脂が孔部に流れ込み、孔部を閉塞してしまう。そのため、本発明の方法ではプリプレグを積層し、緻密化するとともに樹脂がゲル化しない範囲で平板状態で熱処理して樹脂の流动性を小さくし、硬化時に樹脂が孔部に流入して閉塞するのを防止した後に孔明け加工し、その後で成形型に移し、加熱・加圧して硬化させる。

【0008】プリプレグの緻密化は、積層したプリプレグを平板状の治具上に置き、バッグフィルムで覆って周囲をシールした状態で真空引きし、10分以上、好ましくは10～30分保持する方法やプレス金型で押さえつける方法などによりプリプレグどうしを十分に密着させるとともに、硬化後の板厚とほぼ同程度の板厚とすることによって行うことができる。

【0009】熱処理は孔明けしたプリプレグを加熱・加圧して硬化させる際に、樹脂が孔内に流れ出すことのないよう樹脂の粘度を向上させるために行うものであるが、熱処理条件が強すぎると硬化が進行してしまい、常温もしくはヒートガンによる加熱程度では硬化用の形状を有する治具になじませることができなくなるので、樹脂がゲル化しない範囲の条件下で行うことが必要である。具体的な処理条件は使用するマトリックス樹脂の種類や性状などによって異なるが、好ましい熱処理条件の例としてはマトリックス樹脂が180℃硬化タイプの4官能エポキシ樹脂の場合、110～120℃で1～2時間程度、120℃硬化タイプの2官能エポキシ樹脂の場合、80～90℃で1～2時間程度であり、この範囲であれば、通常樹脂がゲル化してしまうことはなく、前記のように治具になじませることができなくなるおそれはない。

【0010】熱処理後のプリプレグは、メカニカルパンチ等を用いて孔明けした後、目的とする製品の形状を有する成形治具に装着し、加熱・加圧して硬化させることによって複合材製多孔面板を得ることができる。

【0011】前記加熱・加圧して硬化させる方法としては、熱処理後孔明け加工したプリプレグを成形型に移し、バッグフィルムを被せて真空引きしたのちオートクレーブ中で加熱・加圧して硬化させる方法が好適である。この場合、プリプレグを孔の無いプラスチックフィルムで覆い、真空引きを確実に行うためにガラス繊維やナイロン繊維製の織物であるブリーザを入れ、バッグフィルムを被せるようにするのが好ましい。また、孔の無いプラスチックフィルムとバッグフィルムとの間に厚さ1～2mmの金属プレートを介在させることによって、真空引き又は硬化の際にバッグフィルムが孔内に引き込まれて孔の上端部が変形するのを防ぐことができる。さらに、プリプレグの表裏両面にナイロン、ポリエチレンなどの薄布（厚さ0.1～0.2mm程度）を介在させることにより、成形治具から硬化品表面に移行した離型剤を容易に除去することができ、次工程で接着作業などがある場合に表面処理として必要なサンディング作業が不要化できる利点もある。

【0012】

【実施例】以下、本発明の実施例を図面を参照しながら説明する。

（実施例1）図1は本発明の1実施例について熱処理、加熱・加圧成形の準備要領を示す説明図である。図1

（a）に示すとおり、プリプレグ1（強化繊維：炭素繊維織物、マトリックス樹脂：180℃硬化タイプの4官能エポキシ樹脂）には強化繊維形態が織物のプリプレグを用い、これを2層積層して、更にメカニカルパンチング加工時の汚染防止のためにプリプレグの両面に離型性のあるプラスチックフィルム2をプリプレグ1の両表面に被せた。これを図1（b）に示す平板状熱処理治具3の上に置き、更にナイロンバッグフィルム4で覆い、周囲をシール材5でシールして真空引きし、室温で30分放置して硬化時の板厚が0.9mmに対し1.0～1.1mm程度まで緻密化した。

【0013】この後、工業用のオーブンに入れ110～120℃で1.5～2時間熱処理を行った。この条件でマトリックス樹脂粘度が上昇し、硬化時の樹脂流動による孔部の閉塞を抑制でき、熱処理後も樹脂がゲル化していないので硬化用の形状を有する成形治具にも、常温もしくはヒートガンで加温してなじませることができる。

【0014】次に、プリプレグフィルム2を被せたままのプリプレグ1に、メカニカルパンチで直径2mmの孔6を3mmピッチで明けた後、プラスチックフィルム2を剥がして図1（c）のように硬化用の形状を有する成形治具7に移し、孔のないプラスチックフィルム8と通気用のブリーザ9を被せ、ナイロンバッグフィルム4で覆い、周囲をシール材5でシールして真空引きし、室温で10分以上放置して成形準備を整えた。

【0015】この成形準備の整ったプリプレグをオートクレーブを使って硬化した。本実施例では約3.5kg/cm²の圧力と180℃の温度で、約2時間加熱を行った。なお、真空引きはオートクレーブ加圧時にオート

クレーブ圧が1kg/cm²を越えた時点で大気開放した。硬化終了後温度と圧力を下げナイロンバッグフィルム4、ブリーザ9及び孔のないプラスチックフィルム8を取り除き、更に成形治具7から硬化品を取り外し、図2の複合材製多孔面板10を得た。図2（a）は複合材製多孔面板の概要を示す斜視図であり、図2（b）は（a）のA-A断面図である。この方法によれば孔明操作が容易であり、加熱・加圧による硬化時にマトリックス樹脂が孔中に流れ出することもなく良好な品質の複合材製多孔面板をえることができるが、図2（b）に示すようにこの複合材製多孔面板10の複合材部11で形成された孔6の上端部にはバッグフィルムの引き込みによる若干の変形が認められる。

【0016】（実施例2）図3に本発明の他の実施例を示す。この例は成形準備の段階で熱処理し、孔明けしたプリプレグ1の両表面に薄いナイロン布12（ここでは東レ社製ナイロンタフタ#100）を被せ、更に孔のないプリプレグフィルム8とブリーザ9との間に厚さ1.6mmの金属プレート13を置いた例である。このように成形準備を整えたプリプレグを前記硬化条件で硬化させることによって、実施例1の硬化品に見られる図2

(b) のような孔上端部の変形はなくなり、図4に示すように良好な形状の孔を有する複合材製多孔面板が得られた。また、薄いナイロン布12を剥ぐことによって離型剤の付着のない硬化品を得ることができた。

【0017】

【発明の効果】本発明の製造方法によれば、プリプレグの孔明けが容易で、硬化中に樹脂の流動により孔が閉塞することもなく、複合材製多孔面板を得ることができ。また、高価な成形治具は不要で、特別な治工具や間接材料類の準備も必要としないのでこの面からも製造コストを低減することができる。さらに、加熱・加圧して硬化させる方法として、熱処理後孔明け加工したプリプレグを成形型に移し、バッグフィルムを被せて真空引きしたのちオートクレーブ中で加熱・加圧して硬化させる

方法を採る場合、金属プレートを介在させることにより孔の変形のない硬化品を得ることができ、プリプレグの表面に薄い布を介在させることにより、成形治具から硬化体への離型剤の移行を防ぐことができる。

【図面の簡単な説明】

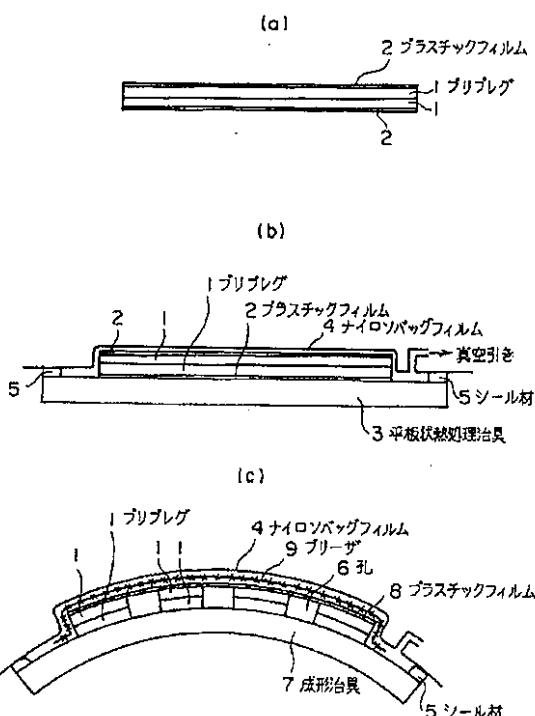
【図1】本発明の第1実施例についてプリプレグの熱処理、加熱・加圧成形の準備要領を示す説明図。

【図2】本発明の第1実施例に係る複合材製多孔面板の状態を示す説明図。

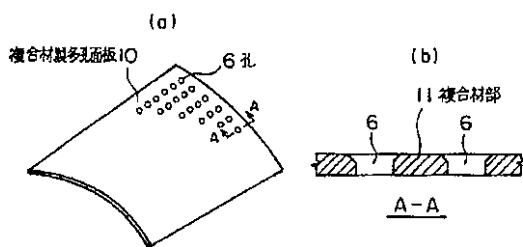
10 【図3】本発明の第2実施例に係るプリプレグの硬化要領説明図。

【図4】本発明の第2実施例に係る複合材製多孔面板の孔の状態を示す断面図。

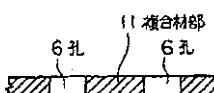
【図1】



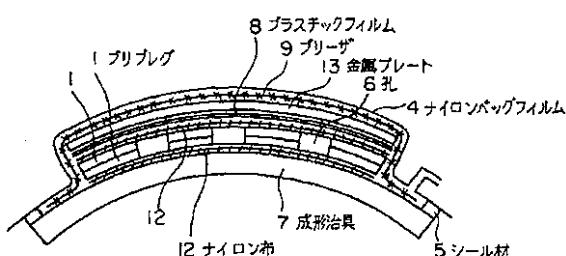
【図2】



【図4】



【図3】



PAT-NO: JP410128778A

DOCUMENT-IDENTIFIER: JP 10128778 A

TITLE: PRODUCTION OF PERFORATED SURFACE
PANEL MADE OF COMPOSITE
MATERIAL

PUBN-DATE: May 19, 1998

INVENTOR-INFORMATION:

NAME
NISHIYAMA, SHIGERU

ASSIGNEE-INFORMATION:

NAME	COUNTRY
MITSUBISHI HEAVY IND LTD	N/A

APPL-NO: JP08289772

APPL-DATE: October 31, 1996

INT-CL (IPC): B29C043/12, B29C043/32, B29C043/56

ABSTRACT:

PROBLEM TO BE SOLVED: To obtain a perforated panel made of a composite material without closing perforations by laminating and densifying predetermined composite material molding materials and increasing the viscosity of them to such a degree that a resin does not flow in perforations at a time of curing by heat treatment to perform perforation processing and subsequently curing them under heating and pressure.

SOLUTION: Two prepgs 1 consisting of reinforcing fibers and a matrix resin are laminated and both surfaces of the prepgs 1 are

covered with releasable plastic films 2 in order to prevent contamination at a time of mechanical punching processing. Thereafter, the whole is heat-treated at 80-120°C for 1-2hr in an industrial oven. The viscosity of the matrix resin rises under this condition and the closing of perforation parts by the flow of a resin at a time of curing can be suppressed. Next, perforations 6 are bored in the prepgs 1 covered with the plastic films 2 and, thereafter, the plastic films 2 are peeled to draw a vacuum by using a molding jig 7 for curing and the prepgs prepared for molding are cured under heating and pressure within an autoclave.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the manufacture method of the porosity face-plate made from composite applied to the engine nacelle of the aircraft by which lightweight-ization is demanded etc.

[0002]

[Description of the Prior Art] In manufacture of the porosity face-plate made from composite applied to the engine nacelle of the aircraft etc., a certain means to prepare a through tube is required for a face-plate. After stiffening the material for composite-material shaping (prepreg is called hereafter) and considering as mold goods, as for the well-known method of performing using a drill or mechanical punch, floor to floor time and costs start in comparison, and since mold goods have the configuration as components, processing is usually difficult further. As one of the methods of solving such a problem, it has the mold rear-face section and the mold surface section. And the mold which has two or more studs in which the gap is kept and projected from this mold surface section, and the tip is respectively sharp is formed. The reinforced plastics impregnation sheet hardened partially is laid on this stud. The manufacture method of a porous reinforced plastics member of having the production process which stiffens the plastics in the above-mentioned sheet is proposed, pressing [press this sheet and this stud so that the above-mentioned stud may penetrate this sheet, and] the above-mentioned sheet on the above-mentioned mold surface (JP,47-2131,A). However, it turned out that this technique also needs to prepare a special die for every configuration of components, and does not necessarily serve as a best policy in respect of processing costs.

[0003] The manufacture method of the porosity face-plate made from composite characterized by for this invention persons heating and pressurizing [fill up with and] casting resin, and making the pore of the prepreg which consists of a strengthening fiber reinforced composite material which formed the pore beforehand, and matrix resin as a means replaced with this method harden it through the thin film made of resin was proposed (JP,8-1690,A). Although this method had the amelioration effect in respect of fabrication time amount or cost, since the indirect material for shaping of casting resin, the thin film made of resin, etc. was comparatively expensive, development of the still cheaper manufacture method was desired.

[0004]

[Problem(s) to be Solved by the Invention] In being made in view of the above-mentioned technical level, and manufacturing the porosity face-plate made from composite, this invention spends big floor to floor time and costs after porosity face-plate shaping made from composite, improves a disadvantageous method and offers the method of manufacturing a porous face-plate simply and cheaply, in respect of manufacturing-cost reduction of breaking a hole, or preparing a special die, carrying out hole down to coincidence at the time of porosity face-plate shaping made from composite, and making it a porous face-plate.

[0005]

[Means for Solving the Problem] This invention contains a mode of following (1) - (4) as a means to solve said technical problem.

(1) as the condition which raised viscosity to a degree with which it heat-treats at 80-120 degrees C for 1 to 2 hours, and resin does not flow in a hole in the case of hardening like backward after carry out laminating eburnation of the material for composite material shaping (prepreg) which consists of strengthening fiber and matrix resin -- a hole -- the manufacture method of the porosity face-plate made from composite characterize by to heat and pressurize and to make it harden after carry out dawn processing.

[0006] (2) A manufacture method of a porosity face-plate made from composite the above (1) characterized by being what carries out heating and pressurization and stiffened in an autoclave after said production process which carries out [a production process] heating and pressurization and is stiffened moves prepreg which carried out after [heat treatment] hole dawn processing to a die and puts and carries out vacuum length of the bag film.

(3) A manufacture method of a porosity face-plate made from composite the above (2) characterized by making a metal plate intervene between said prepgs which carried out after [heat treatment] hole dawn processing and bag films.

(4) The above (2) characterized by making a thin cloth placed between the surfaces of said prepreg which carried out after heat treatment] hole dawn processing, or a manufacture method of a porosity face-plate made from composite of (3).

[0007]

[Embodiment of the Invention] Although what consisted of matrix resin, such as a weave cloth for strengthening woven for strengthening fiber, such as a glass fiber, a carbon fiber, a silica fiber, and an alumina fiber, an epoxy resin and a

bismaleimide resin, polyester resin, phenol resin, and polyimide resin, is desirable as for the prepreg used by this invention, UD (Uni-Directional) prepreg which lengthened and arranged fiber with the one direction and sank in resin can also be used. If it heats and pressurizes and is stiffened after carrying out hole dawn of this prepreg in the unsettled condition, resin will blockade an influx and a pore in a pore at the time of hardening. Therefore, while the laminating of the prepreg is carried out and it carries out eburnation by the method of this invention, it heat-treats in the state of a plate in the range which resin does not gel, and the fluidity of resin is made small, after preventing that resin flows into a pore and blockades at the time of hardening, hole dawn processing is carried out, after that, it moves and pressurizes [heat and] and a die is stiffened.

[0008] Where it placed the prepreg which carried out the laminating on the plate-like fixture, it covered with the bag film and the seal of the perimeter is carried out, vacuum length of the eburnation of prepreg is carried out, and 10 minutes or more, it can be performed by considering as board thickness almost comparable as the board thickness after hardening while fully sticking prepgs by the method of holding preferably for 10 to 30 minutes, the method of suppressing with press metal mold, etc.

[0009] In case heat and pressurize the prepreg which carried out hole dawn and heat treatment stiffens it, it raises the viscosity of resin and performs for accumulating so that resin may not flow out in a hole, but since it becomes impossible to make it get used to the fixture which hardening advances and has a configuration for hardening in the heating degree by ordinary temperature or the heat gun when heat treatment conditions are too strong, it is required in carrying out under the conditions of the range which resin does not gel. Although concrete processing conditions change with classes, descriptions, etc. of matrix resin to be used When matrix resin is 180-degree-C hardening type 4 organic-functions epoxy resin as an example of desirable heat treatment conditions, If it is about 1 - 2 hours at 80-90 degrees C and is this range at 110-120 degrees C in the case of about 1 - 2 hours, and 120-degree-C hardening type 2 organic-functions epoxy resin, there will be no possibility that it may become impossible for resin to usually gel and to make it get used to a fixture as mentioned above.

[0010] the prepreg after heat treatment -- mechanical punch etc. -- using -- a hole -- after carrying out dawn, the porosity face-plate made from composite can be obtained by heating and pressurizing [equip and] and stiffening the shaping fixture which has the configuration of the product made into the purpose.

[0011] After moving the prepreg which carried out after [heat treatment] hole dawn processing to a die as said method of carrying out heating and pressurization and stiffening and putting and carrying out vacuum length of the bag film, the method of carrying out heating and pressurization and stiffening in an autoclave, is suitable. In this case, it is desirable to put in the briza which is the textiles made from a glass fiber or nylon fiber, in order for the plastic film which does not have a hole in prepreg to perform a cover and vacuum length, and to put a bag film. Moreover, it can prevent drawing a bag film in a hole and the upper limit section of a hole deforming in the case of vacuum length or hardening, by making a metal plate with a thickness of 1-2mm intervene between plastic film and bag films without a hole. Furthermore, by making thin cloths (about 0.1-0.2mm in thickness), such as nylon and polyester, placed between front reverse side both sides of prepreg, the release agent which shifted to the hardening article surface is easily removable from a shaping fixture, and when there is adhesion at degree production process, a sanding activity required as surface treatment also has the advantage which can carry out unnecessary]-izing.

[0012]

[Example] Hereafter, the example of this invention is explained, referring to a drawing.

(Example 1) Drawing 1 is explanatory drawing showing the preparation point of heat treatment, heating, and pressing about one example of this invention. The strengthening fiber gestalt carried out the two-layer laminating of this to prepreg 1 (strengthening fiber: carbon fiber textiles, matrix resin: 180-degree-C hardening type 4 organic-functions epoxy resin) using the prepreg of textiles, and the plastic film 2 which has a mold-release characteristic in both sides of prepreg further for the pollution control at the time of mechanical punching processing was put on both the surfaces of prepreg 1 as shown in drawing 1 (a). It placed on the plate-like heat treatment fixture 3 which shows this to drawing 1 (b), further, with the nylon bag film 4, by the sealant 5, the seal of a cover and the perimeter was carried out, they carried out vacuum length, it was left at the room temperature for 30 minutes, and the board thickness at the time of hardening carried out eburnation to about 1.0-1.1mm to 0.9mm.

[0013] Then, it put into the oven of industrial use and heat treatment was performed at 110-120 degrees C for 1.5 to 2 hours. Matrix resin viscosity can rise on this condition, lock out of the pore by the resin fluid at the time of hardening can be controlled, and it can be made to warm and get used also to the shaping fixture which has a configuration for hardening since resin is not gelling after heat treatment in ordinary temperature or a heat gun.

[0014] Next, after breaking the hole 6 with a diameter of 2mm in 3mm pitch by mechanical punch in the prepreg [having put the prepreg film 2] 1, It moves to the shaping fixture 7 which removes plastic film 2 and has a configuration for hardening like drawing 1 (c). The briza 9 plastic film 8 without a hole and for aeration was put, with the nylon bag film 4, the seal of a cover and the perimeter was carried out, they carried out vacuum length by the sealant 5, it was left 10 minutes or more at the room temperature, and shaping preparation was prepared.

[0015] The prepreg in which this shaping preparation was completed was hardened using the autoclave. At this example, it is about 3.5kg/cm². Heating was performed at a pressure and the temperature of 180 degrees C for about 2 hours. In addition, when autoclave ** exceeded 1kg/cm² at the time of autoclave pressurization, atmospheric-air disconnection of the vacuum length was carried out. The plastic film 8 which does not have the lowering nylon bag film 4, briza 9, and a hole in the temperature after hardening termination and a pressure was removed, the hardening article was further removed from the shaping fixture 7, and the porosity face-plate 10 made from composite of drawing 2 was obtained. Drawing 2 (a) is the

perspective diagram showing the outline of the porosity face-plate made from composite, and drawing 2 (b) is the A-A cross section of (a). According to this method, the Kung-Ming actuation is easy, and although the porosity face-plate made from composite of good quality can be obtained without matrix resin flowing out into a hole at the time of hardening by heating and pressurization, some deformation by drawing in of a bag film is accepted in the upper limit section of the hole 6 formed in the composite section 11 of this porosity face-plate 10 made from composite as shown in drawing 2 (b).

[0016] (Example 2) Other examples of this invention are shown in drawing 3. this example -- the phase of shaping preparation -- heat-treating -- a hole -- it is the example which placed the metal plate 13 with a thickness of 1.6mm between the prepreg films 8 and briza 9 which put thin nylon cloth 12 (here nylon taffeta [by Toray Industries, Inc.] # 100) on both the surfaces of the prepreg 1 which carried out dawn, and do not have a hole further, thus, a hole like drawing 2 (b) looked at by the hardening article of an example 1 by stiffening the prepreg which prepared shaping preparation on said hardening conditions -- deformation of the upper limit section was lost and the porosity face-plate made from composite which has the hole of a good configuration as shown in drawing 4 was obtained. Moreover, the hardening article without adhesion of a release agent was able to be obtained by stripping thin nylon cloth 12.

[0017]

[Effect of the Invention] According to the manufacture method of this invention, the hole dawn of prepreg is easy, and the porosity face-plate made from composite can be obtained, without a hole blockading by fluid of resin during hardening. Moreover, an expensive shaping fixture is unnecessary, and since preparation of a special tool or indirect materials is not needed, either, a manufacturing cost can be reduced also from this field. Furthermore, the prepreg which carried out after heat treatment] hole dawn processing is moved to a die as a method of carrying out heating and pressurization and stiffening. When the method of carrying out heating and pressurization and stiffening in an autoclave, after putting and carrying out vacuum length of the bag film is taken, By making a metal plate intervene, a hardening article without deformation of a hole can be obtained and the shift of a release agent to a hardening object from a shaping fixture can be prevented by making thin cloth intervene on the surface of prepreg.

[Translation done.]